EMERSON
OUTDOOR REFRIGERATION CONDENSING UNIT
PRODUCT MANUAL

Copeland® brand products

EMERSON™ Climate Technologies

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1.0 Disclaimer

Thank you for purchasing the Emerson scroll refrigeration condensing unit. We hope that you will find this product meeting your refrigeration needs efficiently and effectively. Please read through this Product Manual thoroughly to familiarize yourself with the value-added features of this product and how to use it optimally to suit your needs. Please do read the following information carefully before proceeding with the rest of the Manual.

The Emerson ZX outdoor refrigeration condensing units should only be installed by suitably qualified and experienced refrigeration technicians. No responsibility can be accepted for damage caused by inexperienced or inadequately trained site technicians or improper system design.

All installation instructions & procedures described in this Manual are recommendations based on what are considered to be good refrigeration trade practices (as applied to this particular product.) The installation contractor may prefer to use variations to these recommendations; however, it is to be noted that the methods described in this manual represent the very minimum required to avoid any subsequent warranty claims for this equipment or its component parts. These instructions do not cover the fundamentals of good electricity or refrigeration practice and are therefore intended for use only by qualified and/or experienced personnel as mentioned above or those technicians certified by us.

These instructions are general in nature for this family of products (ZX) and due to our policy of continuous improvement some of the features/details may not apply to the unit you are installing. If in doubt, please consult your local sales office, quoting unit Model and Serial number as shown on each unit nameplate. In case of ambiguity, the wiring diagram supplied with each unit takes precedence over the diagram in this Manual .

2.0 Introduction to the Emerson outdoor refrigeration condensing unit

Emerson Climate Technologies, a Division of Emerson Electric Ltd. launched the **ZX Condensing Unit (CU)**, a new refrigeration product to the Asian market to primarily meet the demands of the food retail services and logistics sector. The **ZX CU** is an air-cooled, outdoor-type refrigeration condensing unit that uses patented Copeland **scroll technology** as the main driver and has electronic protection, diagnostics and communication features in-built into the compact chassis.

Fig1. Single Fan Unit
(ZX 200, ZX 300 & ZX 400)

2.1 Product Description

The application range of the Emerson ZX CU is between:

* **-15 C to 5C** Evaporating Temperature and
* **27 C and 43 C** Ambient (without Fan Speed Control).

This CU is released with both **R22 and R404A** refrigerants. The single fan units are **ZX 200, ZX 300 and ZX 400** (2, 3 and 4 hp nominal ARI Medium Temperature) and the dual fan units are **ZX 500, ZX 600 and ZX 750** (5,6 and 7.5 hp nominal ARI MT). These CUs are built for robust outdoor applications and have excellent wall-mounting capability and aesthetics, much like air conditioning split outdoor units.

The Copeland brand scroll compressors that power these CUs are manufactured in Asia, ensuring a low-cost high-technology approach to suit the needs of demanding Asian customers.
The ZX is therefore a **very affordable** unit.

When the **large coil- small fan** design is combined with in-built (but optional) fan speed control, the ZX is one of the **quietest** refrigeration CUs in the market.

Fig 2. Dual Fan Unit
(ZX 500, ZX 600 & ZX 750)

State-of-the-art electronics provide protection, diagnostics and communication features in the ZX. These features are controlled by the custom-designed, custom-built E2 Electronics Control Board. The E2 provides:

* **base control** functions related to the system temperature controller, defrost, evaporator fan control etc.

* **compressor protection** e.g. current overload, voltage imbalance, anti - phase reversal etc.

* **liquid injection control** which keeps the discharge head temperature within safe and acceptable limits

* **self- diagnostics** (optional) which receives operating status, alarm and warning from the E2 micro controller unit and displays these for easy and rapid trouble-shooting and maintenance

* **communication capability** that allows the E2 to dial out to specified numbers via a dialer module. Development is in progress to integrate the E2 Board with the CPC Einstein E2 control and monitoring system which will then enable the ZX to be part of an entire "**Emerson Climate Technologies Integrated Store Solution**".

Fig 3. The E2 Control Board

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2.2 Silver and Gold Configuration

The ZX is marketed in two customer-friendly configurations that carry their own unique labels: **SILVER** and **GOLD**. This is clearly explained through the nomenclature diagram and the Bill-Of-Material (BOM) table in Fig 7.

The ZX **SILVER** CU consists of:

* Chassis
* Condenser coil and fan/s
* Electronic control board (E2 Board + protective casing)
* The ZX compressor with a crankcase heater
* Vertical liquid receiver
* Liquid injection
* Electronic expansion valve (EXV) with capillary tube
* Fixed high-pressure and low pressure switches
* Discharge line thermistor and lead wire
* Oil separator
* Liquid line filter drier/sight glass
* Adjustable low pressure switch
* Condenser fan speed control (BOM dependent)
* Compressor sound jacket and
* Suction/liquid service valves.

The ZX **GOLD** consists of everything in the SILVER version plus:

* In-built diagnostic module
* Isolating switch (Circuit Breaker) and
* Buzzer module (supplied loose without cable)

A Defrost module (Fig 4) can be purchased as an accessory with either of the above units and can be built in to the CU at the assembly line.

Fig 4. The Defrost module

Fig 5. The Diagnostic module (with the remote buzzer)

2.3 Control Features

The ZX CU Control System evolves around the E2 Board and one of its primary functions is control of the **Automatic Liquid Injection** system.

The liquid injection method is a unique and Emerson-patented technology. This technology ensures that the ZX compressor operates within a safe envelope. The Injection is based on measurement and relay of the **scroll discharge temperature** to the E2 board which has a built-in algorithm that converts this data into a specific digital signal. This digital signal is sent to a stepper motor driving an Electronic Expansion Valve (EXV). The EXV accordingly supplies sufficient liquid refrigerant to keep the compressor head temperature within safe limits.

Other compressor protection features are:

* **Compressor phase reversal**
  (Scroll compressor will not compress in reverse)
* **Voltage imbalance protection**
* **Loss of phase protection**
* **Motor current overload**
  (Built-in and therefore no external current protection is required),
* **Non-adjustable high and low pressure switches**
  (Automatic reset for a specific number of trips, and lockout thereafter [for high pressure only] that requires manual restart)
* **Liquid floodback protection**
  (measurement of discharge superheat to predict liquid floodback)
* **Fresh start programs**
  (to ensure safe start-up after long period of inactivity)
* **Crankcase heater**
  (energized when compressor stops)

With the highly useful condenser fan speed control function, the operating range can be reduced to -30°C. This is useful at start-up and operation at extremely low ambient conditions. The fan speed control option is recommended when the ambient temperature falls below 25°C. At temperatures below 10°C, fan speed control is no more an option, but an absolute necessity.

The base control function is for connection of optional/ customer applied functions such as:

* **Temperature controller** or thermostat
* **Electric defrost heater**
* Contactor
* **Evaporator fan contactor**
* Output for dialer
* Compatibility with CPC's Einstein control & monitoring
  system (future plan)

2.4 Diagnostic and defrost features

The Diagnostic module (Optional) is also installed within the chassis and has 5 LEDs (Light Emitting Diodes) that can either be ON, OFF or BLINKING. The tabulation of the 5 LEDs with the 3 possible status provides a bird's eye-view of the system status as shown in Fig 6 below:

Status	Event	LED Status				
		D1	D2	D3	D4	D5
Normal	Unit OFF/Phase 'U' or 'N' missing	Off	Off	Off	Off	Off
Normal	Power ON	Off	Off	Off	Off	On
Normal	Compressor ON	Off	Off	Off	On	On
Normal	Fresh Start/Normal Start	Off	Off	Off	Blink	On
Normal	Defrost ON	Off	Off	Blink	Off	On
Fault	DLT Overlimit	Blink	On	Blink	Off	On
Fault	Ambient sensor failure	Blink	On	Off	On	On
Fault	MCT sensor failure	Blink	Off	On	On	On
Fault	DLT Thermistor failure	Blink	Off	Off	On	On
Fault	HP Cut Out	Blink	Off	On	Off	On
Fault	Compressor Over Current	Blink	On	On	Off	On
Fault	Compressor Incorrect Phase sequence	Blink	Blink	On	Off	On
Fault	Compressor Voltage Imbalance	Blink	On	Blink	Off	On
Warning	System Liquid Floodback	Blink	On	On	Blink	On
Fault	Compressor about to turn ON & Ambient sensor failure	Off	Blink	Off	Blink	On

DLT Discharge Line Temperature
MCT Mid Coil Temperature

Fig 6. The Diagnostics module LED status interpretation table

For e.g., if the 5 LEDs display as follows: D1 (blink), D2 (on), D3 (on), D4 (blink), D5 (on), then it is an indication of a potential liquid floodback situation. In such a serious situation, the refrigeration technician who responds to the diagnostic alarm would save valuable time since the LED display enables him to get straight down to the root cause of the issue and evolve a speedy diagnosis: an iced-up evaporator due to defrost malfunction, faulty evaporator fan, faulty or oversized TXV or even wrong evaporator selection (to high ΔT for a low temperature application).

The diagnostic module can be connected to a **remote buzzer** which alerts the recipient through an alarm to any potential issue with the CU.

The ZX defrost module (optional accessory) is **time-initiated and time-terminated** with manual button to override the settings i.e. to stop or start defrost. A remote, manual defrost button can also be connected to the defrost module.

2.5 Advantages

Some key advantages that the Emerson ZX CU has over similar units in the market are:

* It is **extremely affordable** and has a **very low noise level**.
* It is cost effective and more affordable: it comes with in-built state-of-the-art technology such as the E2 Board with several programmed algorithms and the diagnostic module.
* The Copeland brand compliant scroll which has a low noise level (60 dBA at 1m), very low oil carryover (About 0.2 % oil circulation rate compared to the 2-3% in systems using reciprocating compressors)
* The radial compliance of the scroll set which helps to withstand substantial liquid floodback;and
* High efficiency (EER between 2.4 - 2.75 @ ARI MT Rating)

2.6 The ZX Provides exceptional customer value

To our customers, the features of the ZX CU translate into some exceptional values:

Energy saving
More efficient than hermetic and semi-hermetic reciprocating & rotary compressors

Service saving
The diagnostic module can pin-point the issue, reducing valuable service time and downtime.

Reduced food spoilage
High unit reliability and early warning/ diagnostics capabilities that reduce the chances of food spoilage.

Infrequent compressor replacement
Better ability to withstand prolonged liquid floodback & good discharge temperature control

Great aesthetics
Can be installed outdoor, much like a split air conditioning outdoor unit.

Built-in electrical fuses, contactors and connectors
No switchboard requirement; neat, compact and space-saving feature.

Fan speed control
Low sound level and lower energy consumption

Ventilation
Easy to retrofit for discharge air extraction.

Machine room saving
Eliminate wasteful space - mount the unit on the wall

The following explains why the ZX is more **energy efficient:**
Scroll compressor

* **Large suction and discharge ports**
  Reduces pressure losses incurred in suction and discharge processes: physical separation of these ports reduces heat transfer to the suction gas.
* **No leakage past piston rings**
* **Absence of valves and re-expansion volumes: continuous compression and high volumetric efficiency**
* **Flatter capacity curve (than reciprocating compressor systems) over wide ambient range**

Condenser fan-coil design

* **Small fan**
  large coil combination

Condenser fan speed control (optional)

Built-in delay times in the E2 board (reduces total run time)

Lower night loads

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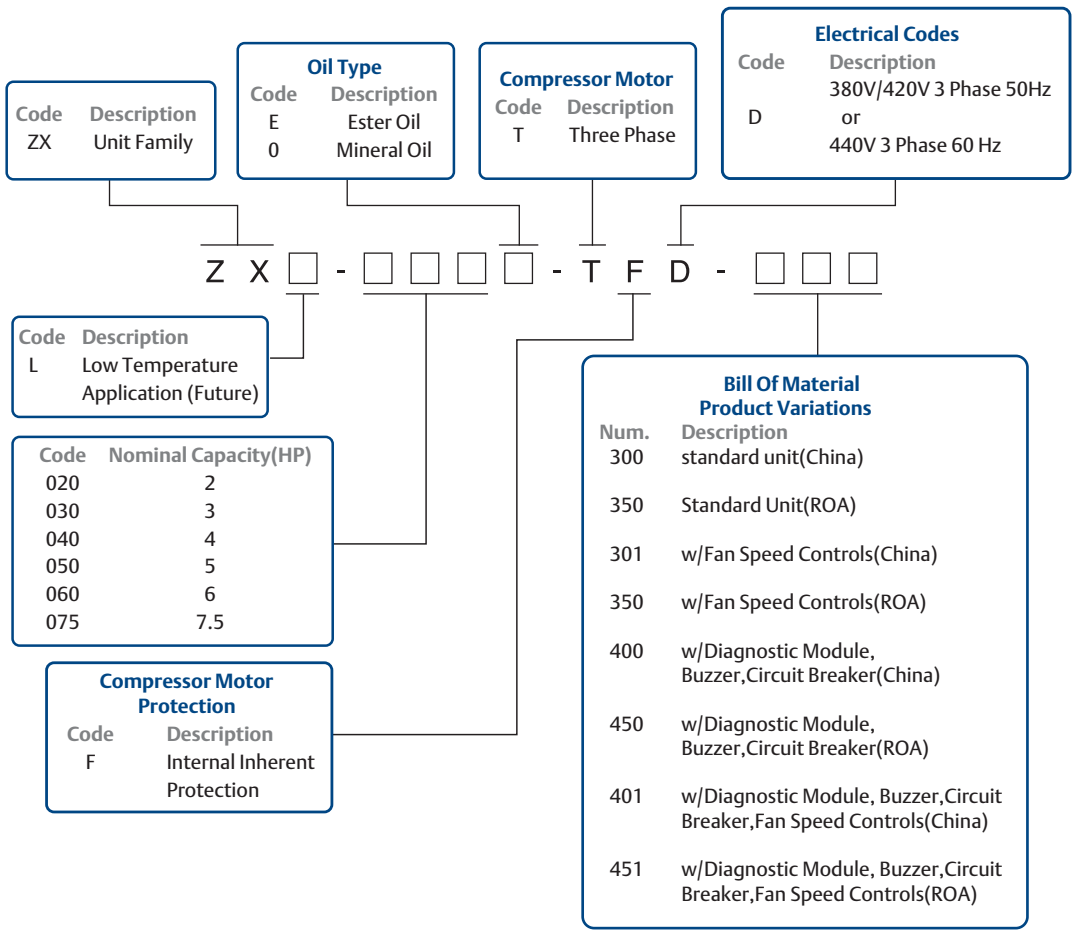
2.7 Application Types

The versatile Emerson ZX is suitable for a wide variety of applications:

Supermarkets (medium to small)
Cold rooms
Convenience stores
Independent cold rooms
Fast food chains and restaurants
Small flake ice machines (250 to 750 kg per day @ -15 ºC evaporating temperature)
Process room cooling (10 ºC room temperature)
Water cooling (PHE/Tube-in-tube evaporators)

3.0 ZX Nomenclature



	Silver				Gold				
Bill of Material (BOM) Numbers	**300**	**350**	**301**	**351**	**400**	**450**	**401**	**451**	**420**
Liquid Line Filter Driver & Liquid Sight Glass									
Oil Separator									
Adjustable Low Pressure Switch									
Fan Speed Controller									
Diagnostic Module									
Romote Buzzer									
Circuit Breaker (Isolating Switch)									
Compressor Sound Jacket									
Defrost Module	**Accessory**				**Accessory**				

Note: BOM **300,301,400,401** is for **China Only**
BOM **350,351,450,451** is for **Rest OF Asia only** (excluding Australia and New Zealand)
BOM **420** is for **Australia and New Zealand only**

Fig 7. ZX Nomenclature

4.0 Receiving your unit

All units are shipped with a holding charge of dry nitrogen inside at a low but positive pressure. Suitable labelling is prominently displayed on both the unit and the packaging.

Caution! It is very important to check that this holding pressure exists at the time you receive the unit from us or our authorized representatives.

Several Schraeder type connections are provided for convenience in checking the integrity of the holding charge.

If, after checking, you find the holding charge non-existent or low, you should immediately inform us or our authorized representative. Failure to do so could void your claim for other related system faults at a later period.

It is also advisable to inspect the rest of the unit for obvious physical damage and inform us or our authorized representative in case any is discovered.

Transit damage is essentially an insurance claim and not covered under warranty.

5.0 Physical layout of the unit

The following illustration identifies the major components and where these are located in the ZX unit.

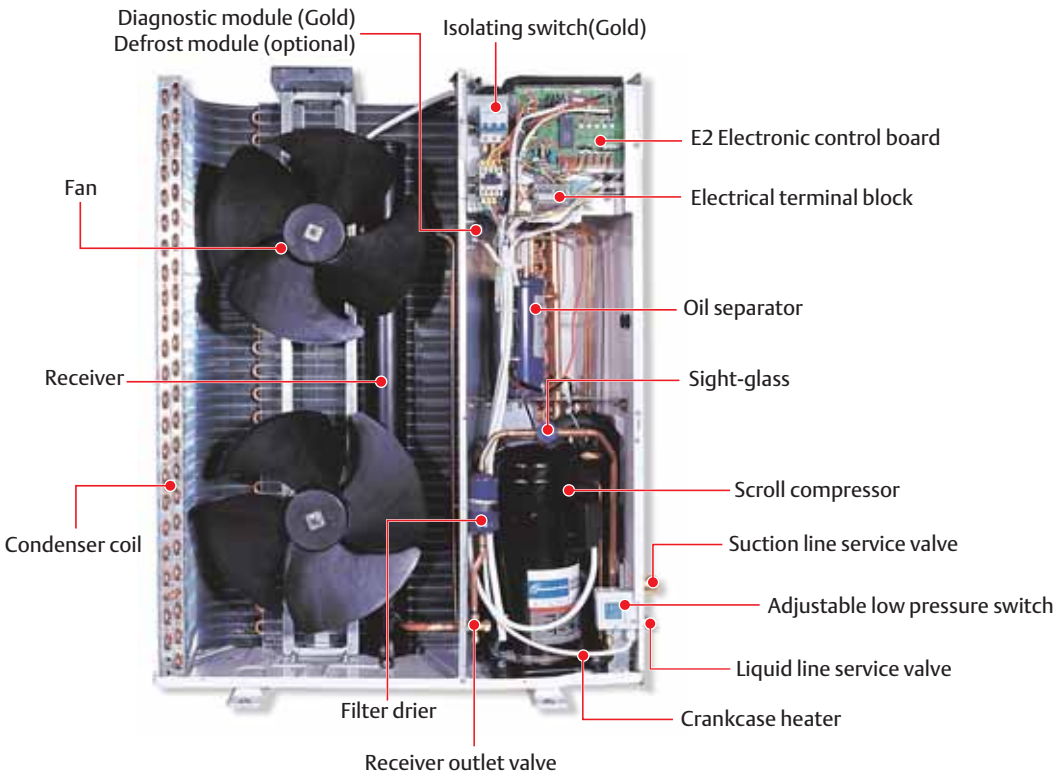


Fig 8. ZX 600 TFD
(components inside your Emerson condensing unit, as viewed when the front panel is removed)

Fig 9. Compressor chamber (close-up)

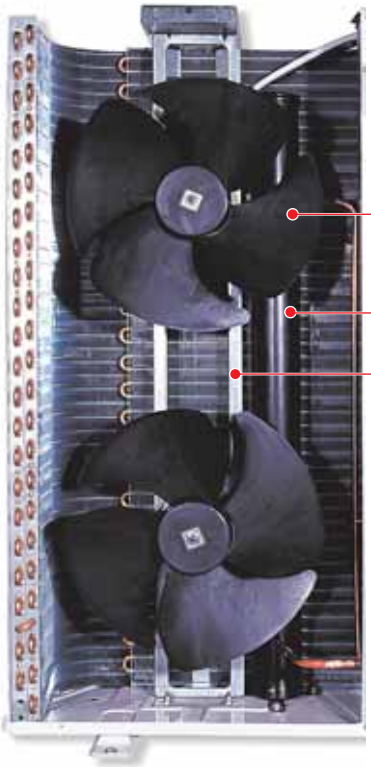


Fig 10. Condenser coil and fan motor chamber

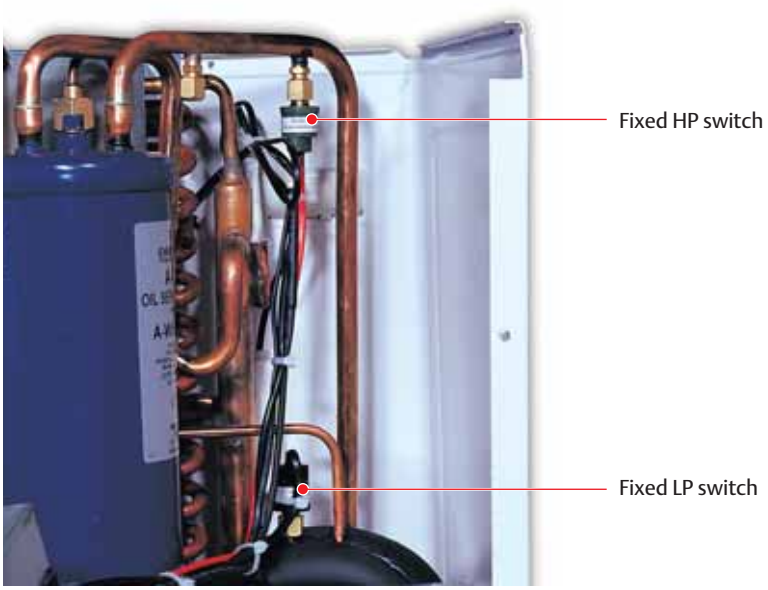


Fig 11. Location of fixed pressure switches

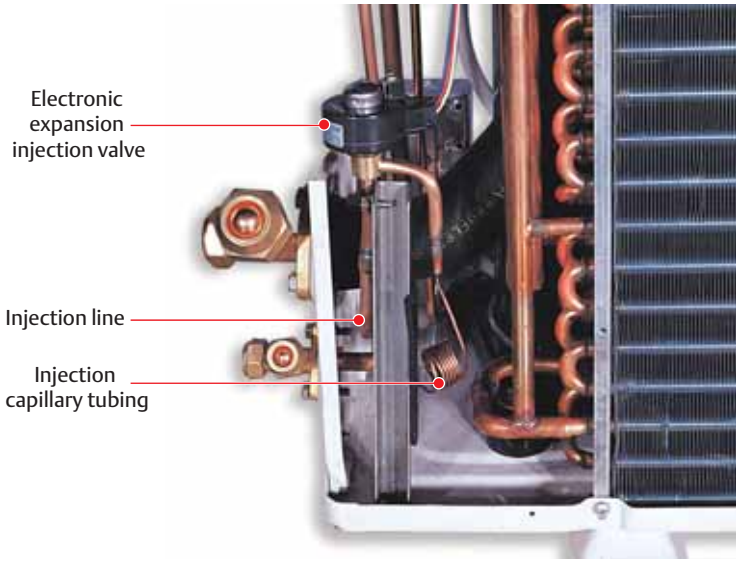


Fig 12 Patented liquid injection system

Fig 13. 3-D view of single fan ZX
(not to scale: not meant to be used for dimensions or installation)

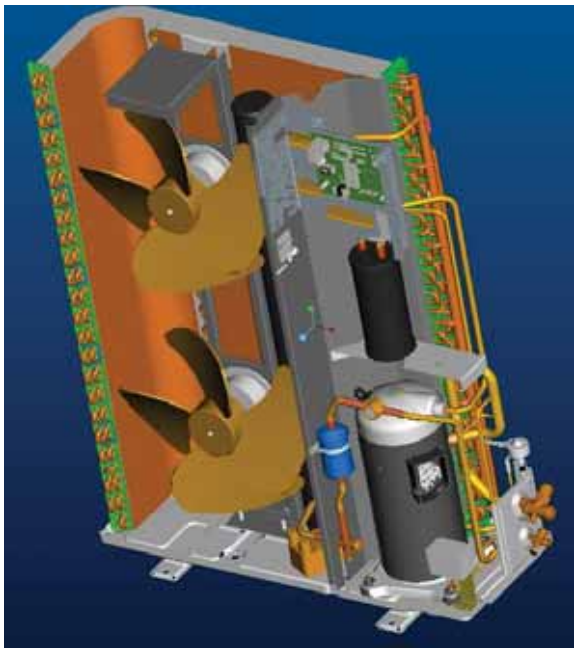


Fig 14. 3-D view of dual fan ZX
(not to scale: not meant to be used for dimensions or installation)

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6.0 Dimensions and installation clearances

Fig 15. shows the overall dimensions of the unit. It is recommended that a clearance of **300 mm** from the wall (or the next unit) be maintained from the unit's left and rear panel; whereas a clearance of **500 mm** should be maintained from the unit's right, top and front panels (as viewed from the front of the unit). Both service access and airflow have been considered in making these recommendations.

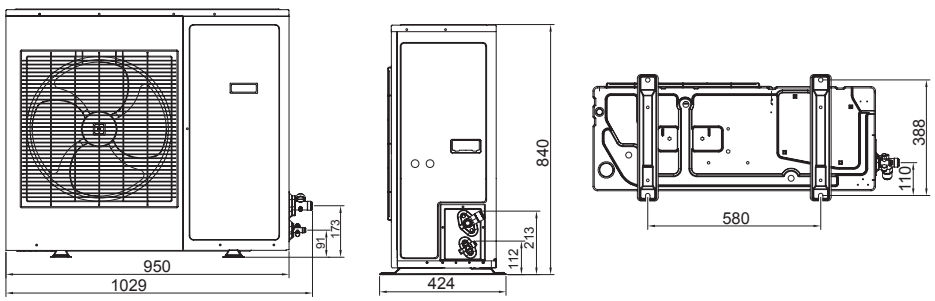
Where multiple units are to be installed in the same location, the contractor needs to consider each individual case carefully. There can be many variations of unit quantities and available space and this manual does not cover all such possible options. But in general, air by-pass around each condenser and between each unit should be avoided at all times.

Ideally, the unit should be mounted level on a solid concrete slab with rubber strips between unit base and concrete. However the condensing unit has also been designed for wall mounting on suitable brackets. In this case, apart from the spatial guidelines given above, an additional consideration is the possible air recycling if units are stacked above and below each other.

Another factor to consider in finding a good installation site is the direction of the prevailing wind. For example, if the air leaving from the condenser faces the prevailing wind, the air flow through the condenser can be impeded, causing high condensing temperatures and ultimately resulting in reducing the life of the unit. A baffle is one remedy for this situation.

Caution! The unit should never be installed adjacent to a dust source (dirt road). External fouling of the condenser fins also leads to high condensing temperatures and will reduce the life of the unit.

ZX0200, 0300, 0400 (Single fan units)



ZX0500, 0600, 0750 (Dual fan units)

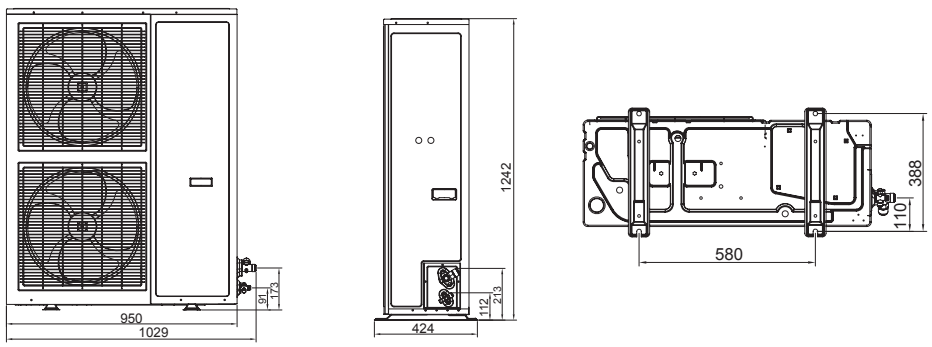


Fig. 15 Physical dimensions

7.0 Essential service/installation tools, equipment and materials

Before start-up, the technician needs to assemble the correct tools and equipment for the task. Apart from the normal refrigeration service technician tools, electrical test equipment and hand tools, the following items are essential for the installation of hermetic refrigeration systems:

* **Vacuum pump** of sufficient size for the total refrigeration system and capable of pulling a vacuum of at least 100 microns. This pump should be fitted with a proper vacuum breaker valve in the event that this pump loses power supply during the evacuation process

* **A four port charging manifold** including:
  - A 3/8" hose to vacuum pump
  - All hoses fitted with removable Schraeder depressors
  - One compound and one pressure gauge

All of this equipm ree, accurate and reliable (See Fig 1

Fig 16. Four port charging manifold

* Clean and new (not recycled) **refrigerant** of sufficient quantity for the refrigerant operating change plus leak testing. Note: Refrigerant cylinders must be of the type that can deliver liquid refrigerant until empty.

* Oxygen-free **nitrogen** and regulators.

* **Reliable electronic vacuum gauge.** (Fig. 17) A clean and leak-free refrigeration system can only be assured if the initial vacuum is deep and holds on testing. This equipment must comply with the standards indicated in the recommended start-up procedures (Section 9.)

Fig 17. A popular electronic vacuum gauge

* Clean and new **compressor oil.**
  - Witco LP 200 is recommended for the ZX R22 units
  - Mobil EAL Artic 22CC is recommended for the ZX R404A units

If the recommended oils are not available in your area, contact us or our nearest distributor/wholesaler for acceptable alternatives

* **Thermometer** to measure discharge temperature and suction temperature

* **Electronic leak detector**

* **Electrical insulation** performance measuring gauge.

8.0 Electrical installation

Caution! This work should be carried out only by suitably qualified electricians.

Please check the unit nameplate and run ample capacity three phase and single phase (including neutral and earth wiring) to each unit. A suitably rated **isolating switch** (this is also an option that could be selected) should be fitted immediately adjacent to each unit .This is not only good practice from a safety standpoint, but is usually a mandatory requirement for most electrical supply authorities today. All incoming phase lines are to be **suitably fused** at the sub-board to protect the installed wiring and the unit.

9.0 Refrigeration piping installation

Caution! This work should be carried out only by suitably qualified refrigeration technicians.

A good understanding of modern scroll compressor hermetic systems is also essential when carrying out this work - particularly for initial evacuation and charging procedures.

Caution: All interconnecting piping should be of refrigeration grade, clean, dehydrated and remain capped at both ends until installation. During installation, if the system is left unattended for any reasonable period of time (even 2 hours), the pipes should be re-capped to prevent moisture and contaminant from entering the system.

It is advisable to insulate both the suction and liquid interconnecting piping between the ZX unit and the evaporator. Usually the suction line is insulated, but the liquid line is not. However, the liquid line can pick up additional heat from the ambient and adversely affect the sub-cooling desirable for the liquid refrigerant before it enters the expansion valve.

Pipe sizing should not only ensure optimum performance and good oil return, but also take into account the full capacity range through which this particular unit will operate.

Pipe runs should be kept as short as possible, using the minimum number of directional changes. Use large radius bends and avoid trapping of oil and refrigerant. This is particularly important for the suction line. The suction line should ideally slope gently toward the unit. Recommended slope is 1/200~1/250. P-traps, double risers and reduced pipe diameters may be required for suction lines where long vertical risers cannot be avoided.

All pipes should be adequately supported to prevent sagging which can also create oil traps. The recommended support distance is as below:

Tube size	Maximum distance between two supports (m)
12.7mm (1/2 inch)	1.20
16.0mm (5/8 inch)	1.50
22.0mm (7/8 inch)	1.85
28.5mm (11/8 inch)	2.20

The solenoid valve should be installed close to the indoor TXV.

To avoid oxidation from taking place inside the tube during brazing, charge **no more than 0.1MPa** nitrogen through the tube when brazing the joint.

There are several books on good trade practices for refrigeration piping available. The above points are intended as good practical guidelines and it is not our intention to repeat the many variations in this manual.

Warning!

Do not assume that the service connection sizes on the unit (at the service valves) are in fact the correct sizes to run your interconnecting refrigeration pipes. The service valve sizes have been selected for convenience of installation and in some cases, as in larger units, these may be too small. However, for the very short pipe run within our units, these service connection sizes are adequate. All interconnecting piping should be sized to satisfy the duty required.

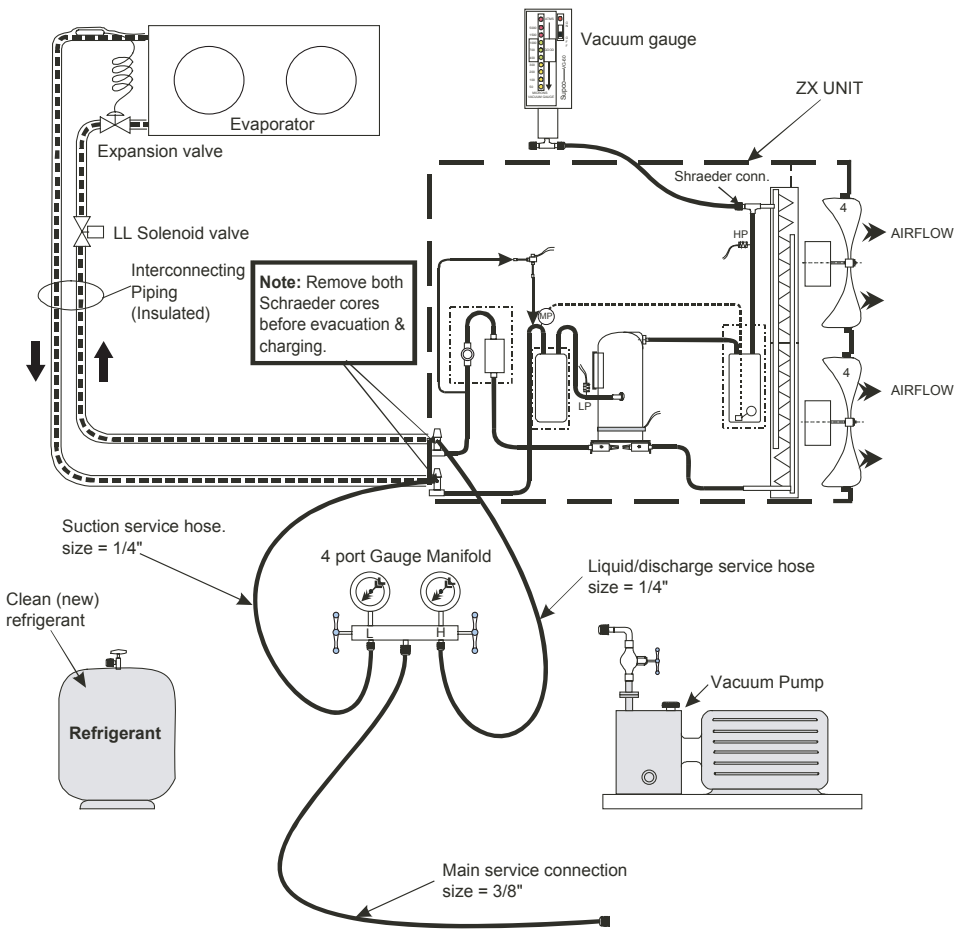


Fig. 18 Commissioning hook-up & essential equipment

10.0 Leak checking and evacuation (See Fig.18)

The following assumes that the installation contractor has certified the condensing unit to be leak-free on arrival (refer to Section 4.0) - this is important to verify before proceeding with the following. Leak checking is particularly important for field-connected systems. Typically, field systems lose as much as 20-30% of their refrigeration charge annually. This is not only an unnecessary expense but also damaging to the environment.

Compressor oil can be lost at the same time as refrigerant and eventually lead to compressor failure. (The time spent on leak testing will eventually reduce the time you need to spend on the evacuation process).

Ensure that all service valves are open during the leak checking process. It is now important to re-check all joints within the unit as well as the external joints created. Since we are aiming at a high degree of vacuum in the next process, the unit must be leak-free first.

10.1 Initial pressure testing (by vacuum and nitrogen)

Step-by-step:

* Use a 4-port gauge manifold with 3/8" hose and connections to the vacuum pump. The vacuum gauge does not have to be connected for this part of the process.
* Then connect gauge lines to both ZX unit service valves.
* In order to remove any non-condensable that may have entered the system during installation, follow these steps: Start the vacuum pump. The liquid line solenoid should be energized at this point, the cabinet (evaporator) fans run and compressor crankcase heaters are energized. This will involve powering up the unit so it is important to disconnect the live feed wire to the compressor contactor (so the compressor cannot run and the crankcase heaters can be energized).
* Now open both valves on the manifold and then open the main vacuum valve on the pump. Run the system until the vacuum level is at around 0.85 bar (as read on the manifold suction gauge.)
* Shut off the main vacuum pump valve. Check for vacuum rise - use the manifold compound gauge. A rise would indicate a large leak.
* If vacuum holds for 10 minutes, break vacuum with nitrogen and pressurize to 10 bar. Check for leaks by feel and sound. (This step is to look for large leaks only.) Repair leakage if leak is detected.

Proceed to step 10.2.

10.2 Leak test (by refrigerant with nitrogen pressurization)

Step-by-step:

* Release nitrogen from system, start vacuum pump and open main pump valve.
* Then evacuate for a second time to 0.85 bar (as read on the manifold gauge.)
* Break this vacuum with R22, after shutting off the main pump valve and then stopping the pump.
* Allow the system to equalize with R22 cylinder pressure (to at least 1.7 bar)
* Then remove the cylinder and increase system pressure, using nitrogen to 15 bar.
* Leak test all joints inside and outside the unit (ie., the complete system) using at least a halide leak detector or preferably an electronic leak detector.
* Repeat all previous steps in this section until the system is completely leak-free.
* Release all pressure from the system, remove the nitrogen connections and reconnect manifold service hose to vacuum pump main valve.

Proceed to step 10.3

10.3 Evacuation

Note that the following procedure is based upon achieving an actual system vacuum standard and it is **NOT TIME DEPENDENT!**

Step-by-step:

* Check suction capability of the vacuum pump with a gauge before commencing evacuation process. The vacuum pump must be rated to achieve a vacuum level of at least 300 microns.
* Connect the vacuum gauge to the system. We have included a convenient point for this on the unit (See Fig.7).
* It is recommended to carry out the evacuation process thrice as detailed below:
* Start the vacuum pump and then open the main valve. It is assumed that the items mentioned in Section 9.1 are still energized and the compressor cannot start

Caution:

Ensure that the vacuum pump cannot be switched off during evacuation - otherwise the pump may lose its lubrication oil to the system and contaminate it.
Therefore the pump must have a Vacuum Breaker fitted to it.

* Step1 evacuation: Bring system down to 1500 microns and then break the vacuum to 2 psig with the same refrigerant.
* Step 2 evacuation: Same as in Step 1.
* Step 3 evacuation: Leave the pump running while checking the vacuum regularly. The target system vacuum is 500 microns.
* Once the target vacuum level is reached, the quality of the vacuum within the system must be tested. This is achieved by shutting off the main pump valve, allowing the internal system pressure to rise and recording the time taken for the vacuum to rise by no more than 300 microns within 30 minutes. (ie., to 100 microns.)

This process is only complete once the vacuum quality is achieved. Then close the two manifold valves tightly. Close the pump main valve, switch off and remove the vacuum pump.

Proceed to step 10.4

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10.4 Charging and commissioning

IMPORTANT!
TO BE CLEARLY UNDERSTOOD PRIOR TO RUNNING ANY SCROLL COMPRESSOR!

It is important to realize that the **scroll compressor design requires system charging as quickly as possible** - with **liquid refrigerant into the liquid line.** This is to avoid running the compressor when there is an insufficient volume of suction gas to cool not only the motor, but also the rotating scrolls. (Temperature builds up very quickly in the scrolls if this is not done!)

DO NOT CHARGE VAPOR IN THE SCROLL COMPRESSOR!

It therefore follows that the suction service valve **must not be fully closed** at any time when the compressor is running. To do so would cause compressor duress as explained above. This valve is provided for ease of connection and for fitting the service gauges without removing the unit panel.

Step-by-step:

* Ensure that there is no power supply to the unit. The liquid line solenoid needs to be kept open for the charging process and it may require a temporary power feed. At this point it is acceptable to leave the crankcase heater off.
* Connect the refrigerant cylinder to main service hose and purge line at the manifold end.
* Then invert the refrigerant cylinder if necessary to ensure only liquid refrigerant can be charged into the system. This will be charged through the high-pressure side of the manifold and liquid service valve.
* The refrigerant cylinder should be weighed at this point to be able to record the final refrigerant charge attained. Note that the standard receiver holds approximately 7.6kg of R22 (at 32°C when it is 80% full).
* Now open the liquid service valve (off the back seat). At ambient, with a good vacuum in the system and the refrigerant cylinder inverted, you should not have to run the compressor at all.
* In cooler ambient, it may be necessary to run the compressor in order to complete the charging process. It is advisable to do this after the previous step, allowing the system/bottle pressures to equalize and almost fully closing the receiver liquid outlet valve (front seat).
* The compressor can then be started, and the unit continues to be charged (with liquid refrigerant through the liquid service valve). The quantity of charge should always be measured.
* Turn off the unit and open the receiver liquid outlet valve (which was almost fully closed earlier).
* The system needs to be operated down to its designated evaporating temperature before you can be sure that the charge is correct. It is at this point that the normal refrigeration operational checks can be carried out-such as checking the liquid line sight-glass for violent bubbles and the operating pressures.
* In the event that the system is still short of refrigerant, repeat the last 4 steps.

11.0 E2 control and operating features

The function of the E2 is to react to the ON/OFF signals it receives from various devices (e.g., thermostat) to operate and protect the ZX unit. The E2 control panel is fitted as standard for the **SILVER** and **GOLD** and has been developed to work in tandem with the ZX compressor to provide the following control and protection systems:

Automatic liquid injection: The E2 automatically injects cool liquid refrigerant into the suction line of the ZX scroll compressor to reduce discharge temperatures generated when the unit operates at increasing compression ratios. The E2 controller reacts automatically to a thermistor embedded in a pocket inserted into the top of the ZX compressor. The controller converts this into a signal for the linear stepper motor (that drives the liquid injection valve) to a position that enables the compressor to continue operating within its safe envelope. **This advanced control strategy extends the operating range and is not normally associated with a standard refrigeration condensing unit of this size - making this feature a highly advantageous differentiation from other refrigeration CUs in the market.**

The E2 is also the **base controller** for the connection of many Emerson-supplied and **customer applied** functions such as:

* **Main refrigeration load controller (or thermostat)**
* **Evaporator electric defrost heater contactor**
* **Evaporator fan contactor**
* **Fan speed control** (found in some **SILVER** and all **GOLD** versions) This option automatically controls fan speed and is useful where low ambient temperatures are experienced- such as might cause a loss of case/cool room temperatures and control. Low ambient temperatures reduce the condensing pressures to such low levels that there is insufficient pressure drop across the expansion device to force the liquid refrigerant through the orifice at the evaporator. As we know, liquid refrigerant being forced through the orifice is what causes part flashing of the refrigerant and brings it closer to the designated boundaries of evaporating pressure and temperature. Control is via the E2 board, a modified E2 micro-controller- with the in-built fan control logic and two additional sensors (condenser coil and ambient sensors).

* **Diagnostic module** (only with **GOLD** version) The option provides the ZX with a self diagnostic function, signaling individual component failure in three ways:
  (a) visible LED combination
  (b) remote audible buzzer
  (c) dialer connection for the purpose of sending a common fault signal through a telephone service to a remote location.

Details on how to obtain diagnostic information from the five module LEDs located on this module was explained in Section 2.4 and Fig 6. The module is mounted below the E2 Board and the LEDs can be easily seen with the front compressor compartment panel removed (Fig 24).

* **Defrost control module (accessory)** This option provides a basic, time-initiated and time-terminated defrost control with additional manual override (push-button). Its location is shown in Fig 24.

Compressor phase reversal
ensures that the compressor runs only in one direction - a necessity for a compliant scroll compressor to compress and pump refrigerant. Reset is automatically set to the correct phase rotation of the compressor.

Voltage protection
ensures that the compressor only operates within the very wide design voltage tolerance of the three-phase motor.

Motor current overload protection is provided (also via the E2) eliminating the need for external current protection for the compressor motor.

Fixed low and high-pressure switches: These are non-adjustable protection devices that prevent the compressor from operating outside its designated envelope of safe evaporating and condensing pressures. Reset is automatic for a set number of trips: the unit will lock out thereafter and require manual restart. This latter feature is important to prevent the ZX unit cycling under these controls for a long period of time.

A **crankcase heater** is wired through a normally closed contact of the compressor contactor in the usual manner, becoming energized whenever the compressor cycles off.

In addition to the above, the ZX has all the following components and features assembled into the **SILVER** and **GOLD** versions:

* **Liquid line assembly** (filter drier and sight glass/moisture indicator)
* **Oil separator**
* **Coated condenser fins** (for light-medium seaside/marine conditions)
* **Adjustable LP switch** for low pressure pump-down control

12.0 Operation & set-up of the E2 board

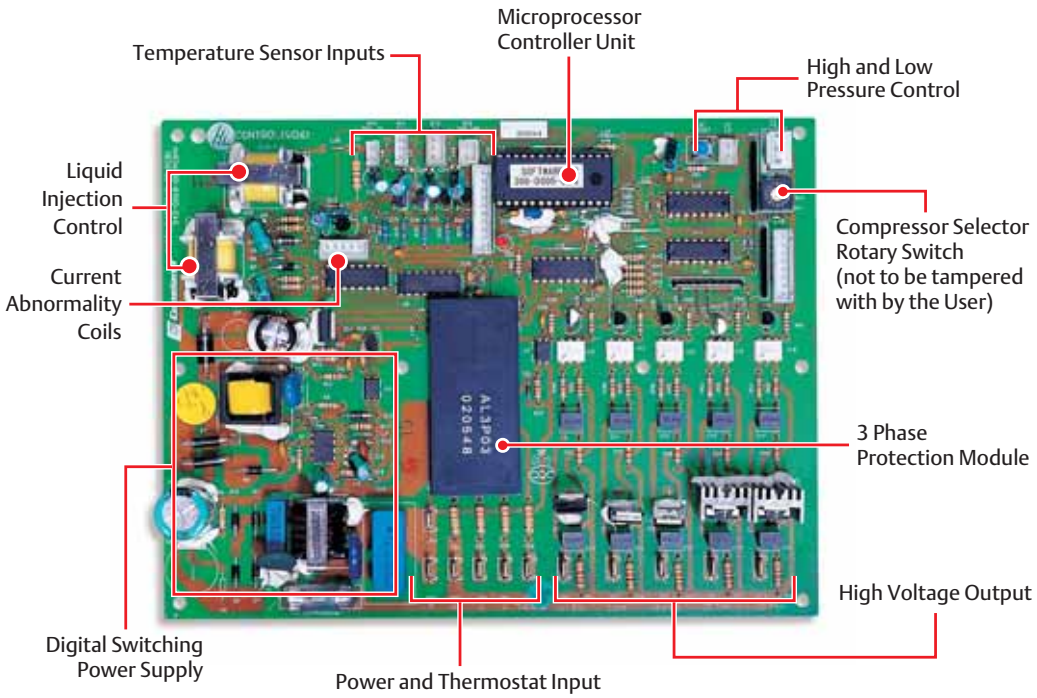


Fig. 19 E2 unit control board - layout and major components (previous page)

Please refer to Fig.18 together with the ZX wiring diagram (for the connection points) in Addendum 17.2 (identify the correct BOM first) at the end of this manual.

12.1 Compressor/unit setting

Each ZX unit model has a unique ZX compressor model and this has to be programmed in the set-up of the E2 controller. For this purpose a compressor rotary switch is located near the top right hand corner of the E2 board (see the diagram in the previous page). This is a factory setting and should not be re-set thereafter. Any tampering with this compressor rotary switch will result in warranty claims becoming **null and void**.

12.2 Compressor motor protection

The E2 protects the compressor motor against the following:

* **Over current**
* **Voltage imbalance (between phases)**
* **Loss of any one phase**
* **Incorrect phase rotation**

If the compressor motor current exceeds a pre-defined current limit (non-adjustable), then the E2 shuts down the unit and generates an error signal to the LEDs on the board.

For this function to operate, two of the main phase supply lines to the compressor (compressor via the contactor) are routed through the **current abnormality coils.**

12.3 Compressor pressure protection

12.3.1 High pressure

A sensor is registered by the E2. The sensing device is a non-adjustable, low voltage pressure switch that will open in the event of an abnormally high discharge pressure (above 2.8Mpa).

* The unit will stop and then restart automatically after a 3-minute delay.
* After 5 successive HP cut-outs over a 1-hour time span, the unit will lock-out.
* Unit reset procedure is as described in the previous table (above).

[Note: Unit lock-out can activate a telephone dialer and buzzer plus signal on the LEDs of the diagnostic module (in the **GOLD** version)]

12.3.2 Low pressure

In a method similar to that of the high pressure sensor, the E2 registers the switching action of a non-adjustable, low voltage pressure switch that will open in the event of an abnormally low suction pressure (below 0.1Mpa).

* The unit will stop and then restart automatically after a 3-minute delay.
* There is NO lock-out for this switch.
* Unit reset procedure is as described in the table above.

[Note: Unit lock-out can activate a telephone dialer and buzzer plus signal on the LED's of the diagnostic module (in the GOLD version)]

To satisfy the low pressure pump-down control function, an adjustable low pressure switch is fitted in the unit.

12.4 Compressor discharge temperature protection

Abnormally high discharge line temperature can damage the scroll sets as well as the compressor motor. The ZX employs a patented liquid injection process that injects liquid refrigerant into the suction line as previously described.

Activation of the liquid injection valve is in response to a clip-on thermistor located at the discharge line of the ZX scroll compressor. The E2 takes this signal and converts it into a signal to the stepper motor of the injection valve, opening the valve linearly in response to increasing discharge temperatures and injecting liquid refrigerant directly into the suction line, reducing the discharge temperature. The discharge temperature setting that triggers this liquid injection operation is set so as to prevent the high temperatures that cause the lubricant to lose viscosity, resulting in compressor mechanical failure.

12.5 Other inputs to the E2 board

12.5.1 Customer supplied control (thermostat)

The E2 accepts a normal 220 volt AC input ON/OFF signal (such as the switching action of a normal commercial thermostat) and relays a similar action as an output to the compressor contactor (refer to the wiring diagram in the Addendum section) in the case of thermostat- controlled system. If the system is controlled by low pressure cut-out for a multiple evaporator system and/or pump-down system, the E2 accepts the signal directly from an adjustable low pressure switch.

12.5.2 Case temperature thermistor

An alternative method of system temperature control can be used. The E2 accepts an input from a common commercial thermistor. This sensing device is fixed inside the indoor load (e.g. refrigerated display case). The sensor has a range of between -40 to+80°C and normally operates in the range of -10 to +3°C. The maximum allowed length for the sensor cable is 10 meters. In this instance, the defrost module (accessory) can be combined to provide a cost effective case-control package.

Fig 20 below explains how the E2 control board reacts to each failure/Incident and the appropriate reset procedures. It also shows the respective control settings.

Fig 20 . E2 Control reference guide

Failure/Incident Type	Setting	E2 Reaction (E2 event in brackets & italics)	Reset Procedure
High pressure cut-out	Contact Open 2.8 ±0.1Mpa Contact Close 2.1 ±0.07Mpa	Execute STOP program and after 3 minutes run normal START program to restart the CU. HP error signal is set to the 6th request for reset and system will be locked out. The Diagnostic LEDs will light-up. ***(HP Cut-out)***	Within 1 hour 5 auto resets are allowed
Low pressure cut-out	Contact Open 0.1 ±0.05Mpa Contact Close 0.2 ±0.05Mpa	Execute STOP program and after 3 minutes run normal START program to restart the CU	
Discharge Gas Overheat	Different settings for different compressors	Execute STOP program and after 3 minutes run normal START program to restart the CU. DLT error signal is set to the 6th request for reset and system will be locked out. The Diagnostic LEDs will light-up.***(DLT Overlimit)***	Within 1 hour 5 auto resets are allowed
Discharge Line Sensor Failure	Different setting for different compressors	If sensor is under-range after 3 minutes of the compressor start-up, sensor failure is confirmed and the diagnostic LEDs will light-up. ***(DLT Thermistor Failure)***	
Incorrect Phase Sequence		If 3 phase supply is incorrectly connected to the contactor terminals, STOP program will be initiated. The diagnostic LEDs will light-up. ***(Compressor Incorrect Phase Sequence)***	Unit will not start unless it is re-wired correctly
Over Current	Different setting for different compressors	Shut down the CU. Unit will start after 3 minutes. The diagnostic LEDs will light-up. ***(Compressor Over Current)***	Automatic Reset
Voltage imbalance		If the voltage drop is beyond the setting in any one of 3 phases, STOP program is executed. The diagnostic LEDs will light-up. ***(Compressor Voltage Imbalance)***	System will restart automatically if voltage rebalances within 3 minutes
Power Cut	This is the case when there is a power outage	Upon the return of power supply, E2 will start the unit on a fresh start mode ***(Fresh Start)***	

Failure/Incident Type	Setting	E2 Reaction (E2 event in brackets & italics)	Reset Procedure
Compressor Rapid Cycling	Minimum 3 minutes OFF time	Any start request will be postponed until 3 minutes if the compressor has stopped within the preceding 3 minutes. If start request is postponed, the diagnostic LEDs will light-up***(Compressor About To Start)***	
Outdoor Sensor Failure		The diagnostic LEDs will light-up. ***(Ambient Sensor Failure)***	
Condenser Mid-Coil Sensor Failure		The diagnostic LEDs will light-up. ***(Ambient Sensor Failure)***	
Both Outdoor and condenser Mid-Coil Sensor Failure		The diagnostic LEDs will light-up. ***(Ambient Sensor Failure)***	
Fresh Start Program	If ambient temperature is less than 38°C when the compressor is about to start	Compressor will start for 3 seconds and stop for 20 seconds. This happens for 3 cycles and then the compressor runs continuously. The diagnostic LEDs will light -up.	

12.5.3 Condenser coil & ambient air thermistors

These two thermistor type sensors are supplied in the ZX CU and are connected to the E2 board when the condenser fan speed control is required. Speed control of the condenser fans is usually applicable when low ambient (low condensing temperatures) are likely to adversely affect refrigeration performance and control.

12.6 Other outputs from the E2 board

12.6.1 Liquid line solenoid valve

An ON/OFF output connection is provided and wired to the main terminal strip for convenience to assist the customer for wiring of the liquid line solenoid valve coil into the unit.

Note: The solenoid valve option (if ordered), is for external fitting by the customer. The solenoid coil voltage rating is to be 220VAC and the board can accommodate current ratings of 50VA (hold) or 100VA (inrush).

12.6.2 Defrost heater contactor coil

An ON/OFF output connection is provided on the E2 board for direct connection of a customer supplied contactor (coil) for convenience when the defrost module (accessory) is included. Terminals are male spade type. Coil voltage rating should be 220VAC and current ratings, 30VA (hold) and 330VA (inrush).

12.6.3 Indoor fan contactor coil

An ON/OFF output connection is also provided on the E2 board for direct connection of a customer supplied contactor (coil) controlling the customer's evaporator fans. Coil voltage rating is to be 220VAC and a maximum current rating of 5 amps (inductive).

13.0 Operation & set-up of the diagnostic module (GOLD) and the defrost module (Accessory)

13.1 The diagnostic module

The diagnostic module is an option that conveys the unit operating and fault status by displaying five LEDs in various combinations.

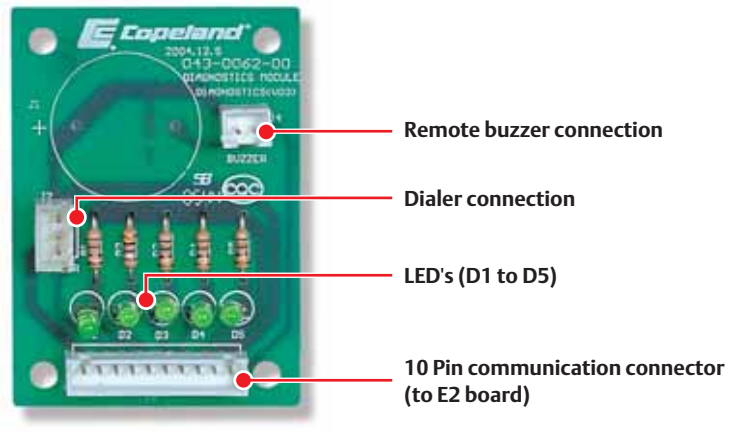


Fig.21 Diagnostic module details

Fig 6. is repeated here for ease of reference :

Status	Event	LED Status				
		D1	D2	D3	D4	D5
Normal	Unit OFF/Phase 'U' or 'N' missing	Off	Off	Off	Off	Off
Normal	Power ON	Off	Off	Off	Off	On
Normal	Compressor ON	Off	Off	Off	On	On
Normal	Fresh Start/Normal Start	Off	Off	Off	Blink	On
Normal	Defrost ON	Off	Off	Blink	Off	On
Fault	DLT Overlimit	Blink	On	Blink	Off	On
Fault	Ambient sensor failure	Blink	On	Off	On	On
Fault	MCT sensor failure	Blink	Off	On	On	On
Fault	DLT Thermistor failure	Blink	Off	Off	On	On
Fault	HP Cut Out	Blink	Off	On	Off	On
Fault	Compressor Over Current	Blink	On	On	Off	On
Fault	Compressor Incorrect Phase sequence	Blink	Blink	On	Off	On
Fault	Compressor Voltage Imbalance	Blink	On	Blink	Off	On
Warning	System Liquid Floodback	Blink	On	On	Blink	On
Fault	Compressor about to turn ON & Ambient sensor failure	Off	Blink	Off	Blink	On

DLT Discharge Line Temperature
MCT Mid Coil Temperature

Other outputs provided by the diagnostic module

Remote buzzer

This provision is for the customer to connect an audible buzzer (in the **GOLD** version), typically within the range of 10 to 30 meters from the E2 board. The alarm is for a common fault signal (any of those listed above). Emerson should be consulted for compatibility between the customer's buzzer and the E2 board, if buzzers other than the types provided in the **GOLD** version are to be used.

Dialer

This provision is for the customer to be able to receive a common fault signal (any of those listed above) at a remote location through the normal telephone network. The E2 communicates with a dialer (to be supplied by Emerson in the future) which communicates with the telephone network.

Liquid floodback warning

Liquid refrigerant entering the compressor in excessive quantities can damage the compressor by diluting the lubricant and creating stress on several components. Proper control of liquid refrigerant should be ensured through system design and is beyond the scope of this controller. However, the E2 controller is designed to sense and alert the user to system liquid flood back. Immediate field service is essential to solve the problem.

This will only serve as a warning signal to the user and will not terminate the system.

13.2 The defrost module

This factory-supplied accessory provides a basic time-initiated, time terminated defrost controller. It is located below the electrical panel inside the top of the compressor compartment (Fig 25). It includes a manual actuating button for the customer to override the initiation settings at any time. This button also initiates defrost in the event of an iced-up call when the system needs to be de-iced immediately. Refer to Fig.22 wherein the main components have been identified.

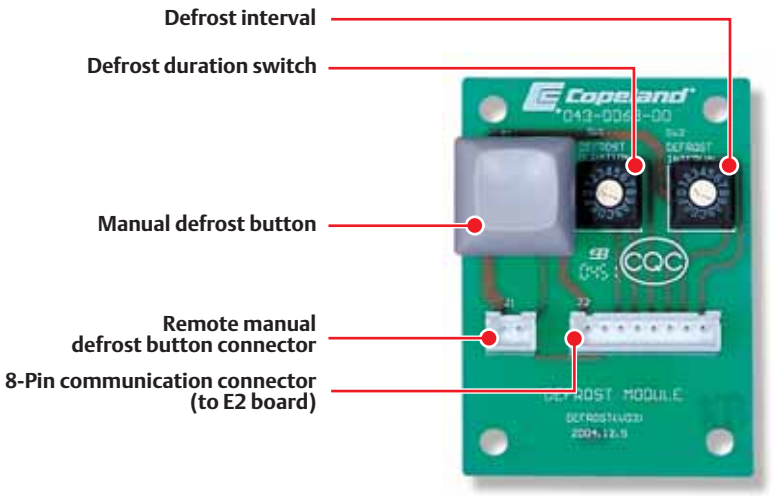


Fig.22 Defrost module details

The two rotary switches (SW1 & SW2) are for setting the defrost interval between defrosts and defrost duration respectively. The table below (Fig.23) conveys the values for each setting of each switch.

SW1	Interval between defrosts (hours)	SW2	Defrost duration (minutes)
0	No Defrost	0	No Defrost
1	1	1	5
2	2	2	10
3	3	3	15
4	4	4	20
5	5	5	25
6	6	6	30
7	7	7	35

Fig. 23 Defrost module settings

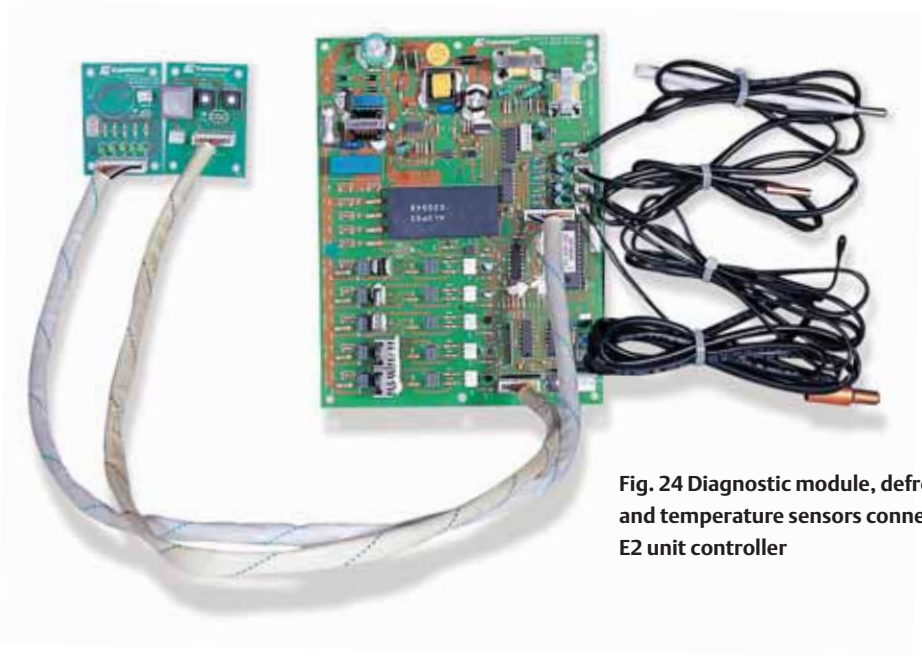


Fig. 24 Diagnostic module, defrost module and temperature sensors connected to the E2 unit controller

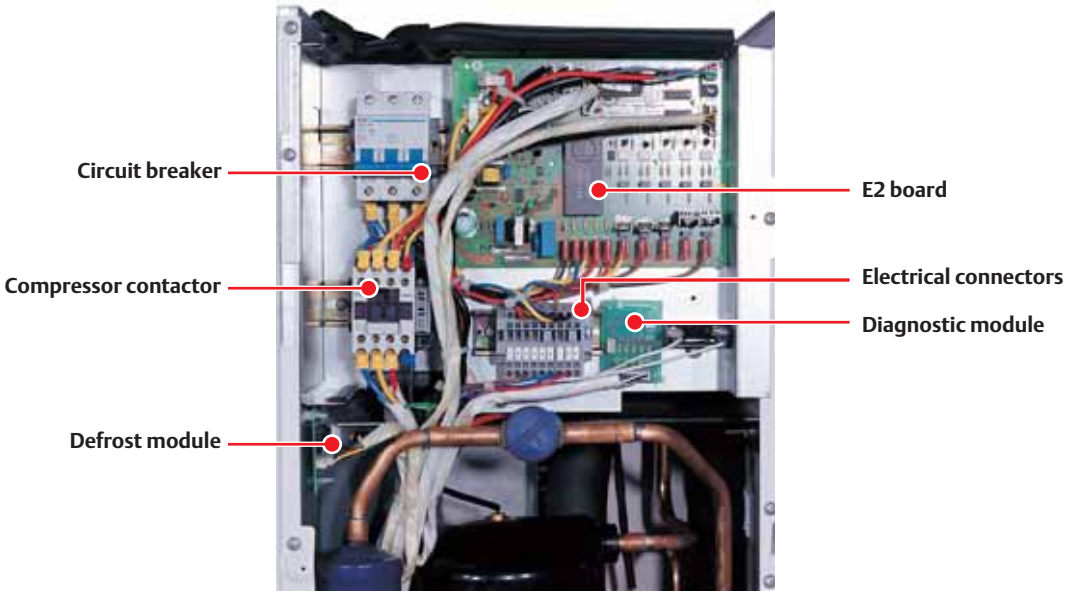


Fig. 25 Location of diagnostic module, circuit breaker, compressor contactor and electrical connectors and connections to the E2 unit controller

14.0 Maintenance

Condenser fins:

Over time, with exposure to ambient air, condenser fins can become dirty. Dirty coil surfaces result in high condensing temperatures and poor unit performance. Regular cleaning is recommended, the frequency of cleaning being dependent on the installation and the surrounding environment. As a general guide, it is advisable to do this at least **once-in-two-months.**

As a general rule, and for a clean environment, we recommend that the fins be cleaned with liquid detergent diluted with clean water. The ZX has a well-designed chassis with gradual slope towards a large drainage hole. If the unit is installed level, any cleaning solution should be able to drain away. Before washing, a light brush downward (in the direction of the fins) should be done to remove heavy deposits.

WARNING:

DO NOT USE ACIDIC SOLUTIONS TO CLEAN THE COIL. After cleaning, the fins should be brushed lightly with a proper fin comb (13 FPI).

Electrical connections:

All condensing units generate some vibration. The ZX is no exception, except that the vibration level of compliant scroll compressors is less severe than that of reciprocating compressors. Because of this, the ZX can be mounted on simple, less expensive rubber strips.

Over time, however, and also due to temperature extremes within the unit housing, electrical terminations can come loose. It is suggested that the main electromechanical terminations be checked for tightness at least **once-every-half-year.** The main terminal strip and compressor contactor are the components most likely to be effected by vibration.

WARNING!

Make sure that the unit isolating switch is turned off before undertaking this work!

Most of the control wiring (and terminations) are low voltage connections and should not be affected in the same way as the heavier electro-mechanical terminations. Most terminations are of the crimped type and inside plastic plugs. Visual inspection **every half-year** should be sufficient for these terminations.

E2 control panel

This is a fixed PCB (Printed Circuit Board) and is not an item requiring routine maintenance. It does have one fuse as protection and the wiring diagram (located in the Addenda 17.2 in the end of this manual) provides a guide to its location on the board. It is important not to upgrade this from its designated 3.5A rating; otherwise the E2 will not be protected. If the fuse keeps blowing, this is usually an indication that some external (to the E2 panel) and connected device (ie. solenoid valve coil) is causing the problem.

The E2 has been designed with a simple, transparent plastic dust-protector cover and it should be a simple matter to remove two screws from the front of the unit to allow the E2 to be removed for inspection. The attached wiring harnesses have been designed to assist in this as well.

Caution

We strongly advise the use of anti-static finger-cots when handling the components on the E2 Board. The E2 Board casing must not be removed and the E2 Board tampered with, unless absolutely necessary!

Routine leak testing

All joints within the system should be checked for leaks during site visits. If you find oil imprint around the joints or in the ground near the joints, there may be a leak in the joint.

All joints within the system should be leak tested **once-a-year**. This is purely a recommendation based on thermal expansion/contraction that normally occurs in the unit piping.

Condenser fan(s) & motor(s)

An **annual** inspection of these items is recommended. Fastenings can come loose, bearings may wear and fans may require cleaning of solid deposits that can cause rotational imbalance. Motors come with lifelong lubrication bearings that do not require lubrication on a routine basis; they just need to be checked for wear.

15. Spare parts' list

For Silver and Gold

PART NO.	PART NAME
050-6931-00	FAN MOTOR
083-6931-00	FAN BLADE
074-1203-00	BRACKET-FAN MOTOR MOUNTING ZX0200/0300/0400
543-0018-00	E2 CONTROL BOARD
012-0240-00	CONTACTOR
021-0273-00	CONNECTOR-JUMPER
071-0574-00	FUSE
521-0218-00	CONNECTOR-FUSE HOLDER
043-0062-00	DIAGNOSTIC MODULE
043-0063-00	DEFROST MODULE
014-0065-00	CAPACITOR
043-0111-00	THERMISTOR- Discharge
043-0082-00	COIL IN SENSOR
043-0071-00	AMBIENT SENSOR
043-0072-00	MID COIL SENSOR
ZX15KC-TFD-524	ZX COMPRESSOR FOR ZX 0200
ZX21KC-TFD-524	ZX COMPRESSOR FOR ZX 0300
ZX30KC-TFD-524	ZX COMPRESSOR FOR ZX 0400
ZX38KC-TFD-524	ZX COMPRESSOR FOR ZX 0500
ZX45KC-TFD-524	ZX COMPRESSOR FOR ZX 0600
ZX51KC-TFD-524	ZX COMPRESSOR FOR ZX 0750
018-0084-01	CRANKCASE HEATER(ZX0200/0300)
018-0084-00	CRANKCASE HEATER (ZX0400/0500/0600/0750)
028-8378-00	TUBE-CAPILLARY-FOR ZX0200

PART NO.	PART NAME
028-8378-01	TUBE-CAPILLARY-FOR ZX0300
028-8378-02	TUBE-CAPILLARY-FOR ZX0400
028-8378-03	TUBE-CAPILLARY-FOR ZX0500
028-8378-04	TUBE-CAPILLARY-FOR ZX0600
028-8378-05	TUBE-CAPILLARY-FOR ZX0750
010-7007-00	ELECTRONIC EXPANSION VALVE(EXV)
023-0063-00	EXV COIL ZX0200/0300/0400
023-0063-01	EXV COIL ZX0500/0600/0750
013-7014-00	LIQUID LINE FILTER DRIER
070-6904-00	LIQUID LINE SIGHT GLASS
077-0033-00	RECEIVER ZX0200/0300/0400
077-0032-00	RECEIVER ZX0500/0600/0750
032-0588-00	CLIP-FOR EXV
085-7050-00	FIXED SETTING HIGH PRESSURE SWITCH ZX0200/0300/0400
085-7051-00	FIXED SETTING LOW PRESSURE SWITCH ZX0200/0300/0400
085-7049-00	ADJUSTABLE LOW PRESSURE SWITCH
005-1279-01	PLATE- LEFT FRONT ASSEMBLY ZX0200/0300/0400
005-1279-00	PLATE- LEFT FRONT ASSEMBLY ZX0500/0600/0750
005-7217-00	COVER-PANEL FRONT RIGHT FOR ZX0200/0300/0400
005-7193-00	COVER-HANDLE
005-7193-01	HAND GRIP
005-1282-00	FAKE HAND GRIP
032-0592-00	HOLDER FOR SENSOR

PART NO.	PART NAME
066-0391-00	CONDENSER - ZX 0200
066-0390-00	CONDENSER - ZX 0300
066-0389-00	CONDENSER - ZX 0400
066-0388-00	CONDENSER - ZX 0500/0600
066-0387-00	CONDENSER - ZX 0750
010-7006-01	VALVE-SERVICE ZX0400/0500/0600/0750
010-0103-00	VALVE-SERVICE:1/2
010-7006-02	VALVE-SERVICE: ZX0200/0300
010-7009-01	HAND VALVE
085-7052-00	FIXED SETTING HIGH PRESSURE SWITCH ZX 0500/0600/0750
085-7053-00	FIXED SETTING LOW PRESSURE SWITCH ZX 0500/0600/0750
005-7216-00	COVER-PANEL FRONT RIGHT: FOR ZX0500/0600/0750
077-0028-00	OIL SEPARATOR
012-0239-00	CIRCUIT-BREAKER (ISOLATION SWITCH)
562-7049-00	BUZZER MODULE

16.0 Trouble shooting

The Diagnostic module, which is available with the GOLD version of the unit, alerts a technician to the following conditions:

Discharge Line Temperature Over limit
Ambient Sensor Failure
Mid Coil Temperature Sensor Failure
Discharge Line Temperature Thermistor Failure
High Pressure Cut Out
Compressor Over Current
Compressor Incorrect Phase Sequence
Compressor Voltage Imbalance
System Liquid Floodback

Troubleshooting for this unit is not very different from that for any other type of unit except that the feedback from the diagnostic module (Refer to the Diagnostics Interpretation Table Fig 6 which is pasted inside your unit front cover) helps the technician to get to the core issues much more quickly. The E2 Control Reference Guide in Fig 20 helps the user understand how the E2 electronics board reacts to system-safety settings and resets. The conditions above are CU and system-related conditions. By applying some basic refrigeration troubleshooting guides (but not limited to these) as below with a basic gauge manifold, the technician can also get a fair idea about the condition of the system:

		Possible Causes/Effects
Discharge Pressure	**Low**	Refrigerant Shortage Dirty Evaporator Iced-up Evaporator Low Superheat Setting at TXV Restriction in Refrigeration system
	High	Front Seated Receiver Rotalock Valves Lack of Ventilation around Unit Refrigerant Overcharge Presence of Non-Condensibles High Ambient Temperatures
Suction Pressure	**Low**	Oversized Unit Undersized Evaporator Liquid Flashing in Liquid Line
	High	Oversized Evaporator Excessive Airflow over Evaporator Refrigerant Overcharge

With additional tools, the technician can find out more about the system using the following table as a guide:

	Discharge Pressure	Discharge Temperature	Suction Pressure	Superheat	SubCooling	Amperage Draw
Refrigerant Overcharge	High	Low	High	Low	High	High
Refrigerant Undercharge	Low	High	Low	High	Low	Low
Restriction at the Filter Drier	Low	High	Low	High	High	Low
Low Evaporator Airflow	Low	Low	Low	Low	High	Low
Blocked or Dirty Condensor Coil	High	High	High	Low	Low	High
TXV with lost bulb charge	Low	Low	Low	High	High	Low
High Evaporator Airflow	High	High	High	High	Low	High
Dragging or Seizing Compressor	Low	High	High	High	High	High
Electrical Phase Imbalance	Low	High	High	High	High	Low
Non-Condensibles in system	High	High	High	High	Low	High

High : Higher than Normal **Low : Lower than Normal**

Addendum 17.1 - General technical data: R22 & R404A

Unit Model R22 (R404A)	**ZX 200 (20E)**	**ZX 300 (30E)**	**ZX 400 (40E)**	**ZX 500 (50E)**	**ZX 600 (60E)**	**ZX 750 (75E)**
Compressor Model R22	ZX 15 KC TFD	ZX 21 KC TFD	ZX 30 KC TFD	ZX 39 KC TFD	ZX 45 KC TFD	ZX 51 KC TFD
Compressor Model R404A	ZX 15 KCE TFD	ZX 21 KCE TFD	ZX 30 KCE TFD	ZX 39 KCE TFD	ZX 45 KCE TFD	ZX 51 KCE TFD
TFD 380-420-3-50 MRA (A)	4.3	5.7	7.4	8.9	11.5	13.2
TFD 380-420-3-50 LRA (A)	26	40	49.3	65.5	74	101
Fan Motor(W)	60					
Number of Fans	1			2		
Total Fan Motor(W)	60			120		
Fan Diameter(mm)	450					
Fan Speed(r/min)	830					
Nominal Capacity(kW) R22	3.85	5.60	7.30	9.50	11.20	12.60
Nominal Capacity(kW) R404A	4.30	6.00	7.80	10.50	11.80	13.20
Nominal Input(kW) R22	1.60	2.10	2.90	3.50	4.30	4.90
Nominal Input(kW) R404A	1.90	2.00	3.40	4.30	4.90	5.50
Nominal Input(hp)	2	3	4	5	6	8
Receiver@80% Capacity at 32 degC(kg)	7.6					
Oil Type R22	Witco LP-200					
Oil Type R404A	Mobil EAL Artic 22CC					
Oil Charge(Litre)	1	1.1	1.85	1.85	1.85	1.85
Suction(in OD)	3/4"	3/4"	7/8"	7/8"	7/8"	7/8"
Liquid(in OD)	1/2"					
Weight(Kg)	95	100	112	118	121	140

1.Maximum Running Amperes 2.Locked Rotor Amperes 3.At ARI Medium Temperature conditions

Note:

ARI:(Air-Conditioning & Refrigeration Institute) ratings

Medium Temperature Rating (Compressors)

Evaporating Temperature: -6.7°C

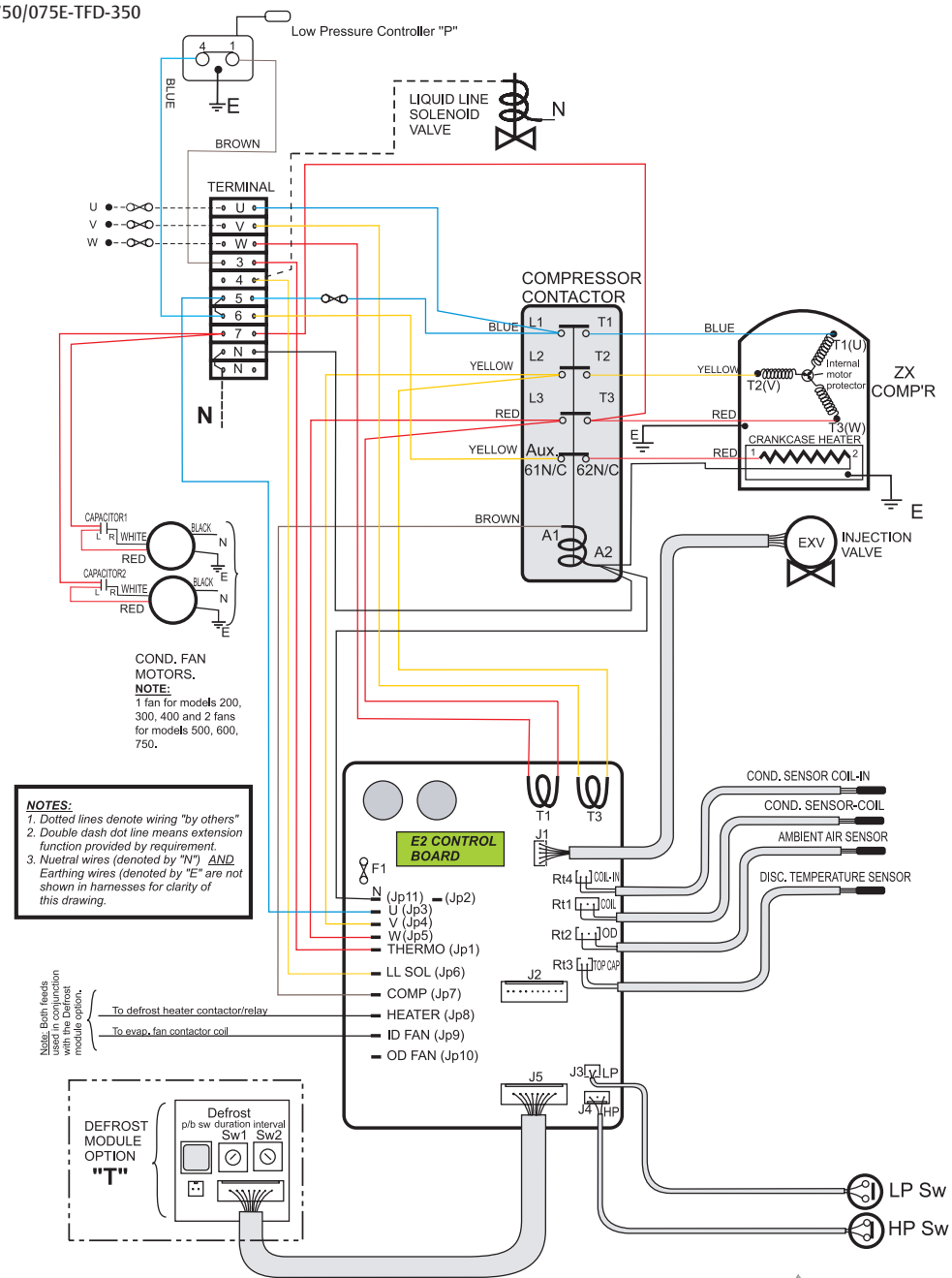
Condensing Temperature: 48.9°C

Return Gas Temperature: 18.3°C

Sub-cooling: 0 K

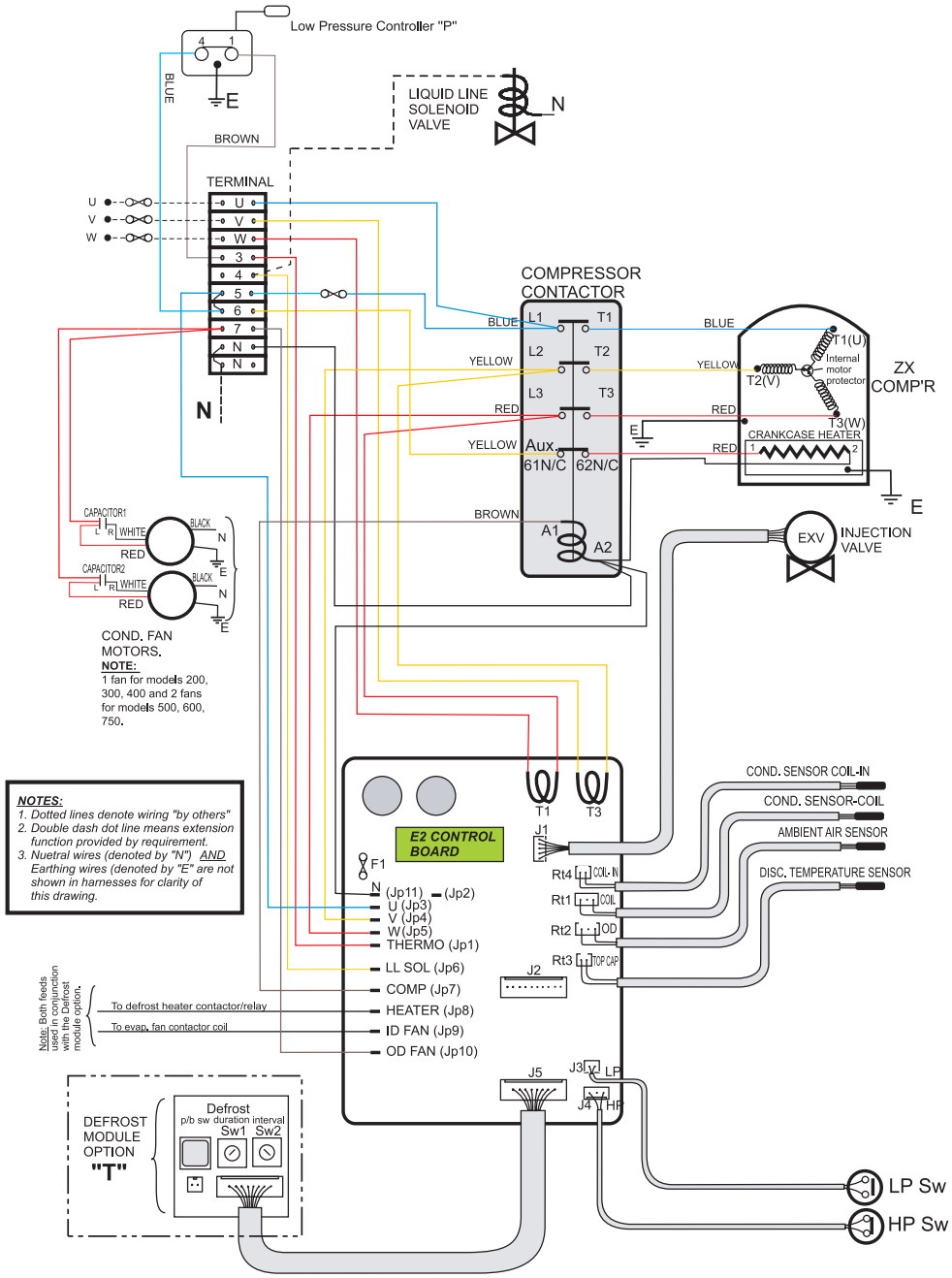
Addendum 17.2(a) - Wiring diagram (BOM 300 & 350)

ZX0200/020E~0750/075E-TFD-350



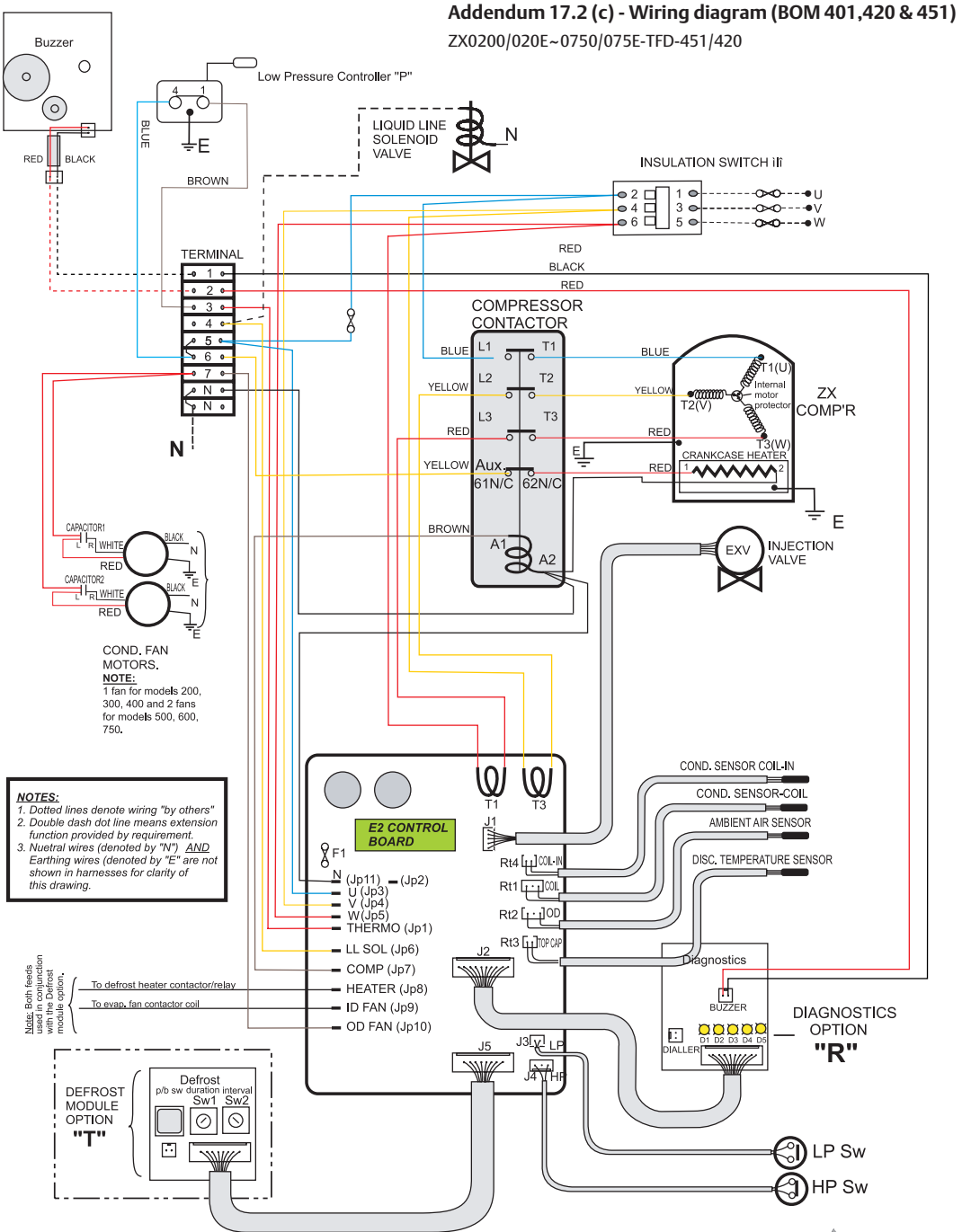
Addendum 17.2 (b) - Wiring diagram (BOM 301 & 351)

ZX0200/020E~0750/075E-TFD-351



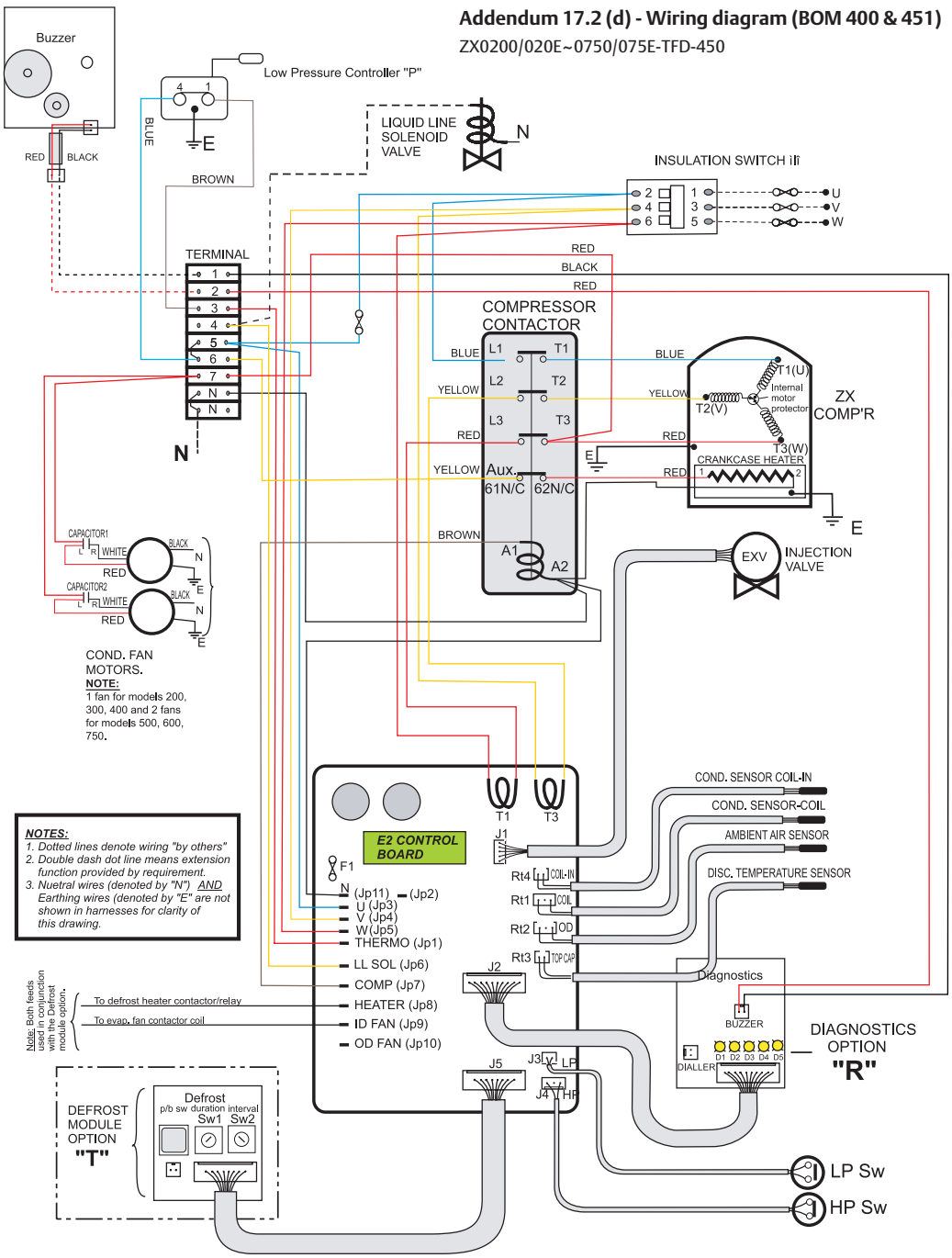
Addendum 17.2 (c) - Wiring diagram (BOM 401,420 & 451)

ZX0200/020E~0750/075E-TFD-451/420



Addendum 17.2 (d) - Wiring diagram (BOM 400 & 451)

ZX0200/020E~0750/075E-TFD-450



Addendum 17.3 Capacity (kW) & Power (kW) at 50Hz for refrigerant R22

Model	Ambient Temp.°C	Capacity (kW)					Power (kW)				
		Evaporating Temperature (°C)					Evaporating Temperature (°C)				
		-15	-10	-5	0	5	-15	-10	-5	0	5
ZX0200	27	2.84	3.61	4.18	4.95	5.87	1.36	1.40	1.45	1.51	1.57
	32	2.65	3.33	4.01	4.75	5.61	1.49	1.54	1.62	1.68	1.75
	38	2.38	3.11	3.81	4.55	5.37	1.66	1.78	1.88	1.92	1.96
	43	1.93	2.74	3.48	4.23	5.06	1.83	1.88	2.00	2.10	2.16
ZX0300	27	4.46	5.43	6.48	7.67	9.09	1.83	1.92	2.04	2.07	2.10
	32	4.12	5.07	6.10	7.28	8.69	1.97	2.07	2.18	2.20	2.31
	38	3.68	4.62	5.65	6.85	8.29	2.23	2.33	2.43	2.44	2.59
	43	3.27	4.22	5.27	6.50	7.97	2.48	2.58	2.67	2.76	2.86
ZX0400	27	5.98	7.20	8.57	10.03	11.54	2.57	2.64	2.75	2.90	3.00
	32	5.46	6.73	8.13	9.62	11.16	2.73	2.82	2.98	3.10	3.24
	38	4.72	6.01	7.42	8.93	10.48	3.00	3.18	3.30	3.40	3.55
	43	4.09	5.37	6.78	8.27	9.80	3.20	3.32	3.58	3.70	3.84
ZX0500	27	7.48	9.19	10.96	12.82	14.82	2.90	3.05	3.20	3.32	3.50
	32	7.10	8.72	10.45	12.30	14.36	3.40	3.38	3.60	3.70	4.00
	38	6.55	8.07	9.74	11.61	13.71	3.80	3.90	4.10	4.30	4.50
	43	5.71	7.14	8.77	10.65	12.81	4.30	4.30	4.50	4.70	5.00
ZX0600	27	8.50	10.41	12.49	14.72	17.80	3.39	3.57	3.75	4.02	4.29
	32	7.71	9.63	11.71	13.94	16.30	3.75	3.93	4.11	4.29	4.55
	38	6.81	8.42	10.57	12.85	15.26	4.20	4.38	4.55	4.73	4.91
	43	5.91	7.23	9.40	11.78	14.26	4.73	5.00	5.27	5.45	5.54
ZX0750	27	10.03	12.37	14.91	17.73	20.89	4.07	4.26	4.46	4.67	4.90
	32	9.45	11.64	14.12	16.96	20.21	4.47	4.64	4.87	5.17	5.54
	38	8.83	10.85	13.25	16.08	19.42	5.03	5.19	5.47	5.86	6.38
	43	8.18	10.00	12.29	15.09	18.49	5.58	5.72	6.03	6.50	7.15

Note: Capacity at 18.3°C return gas temperature and 0 K sub cooling

Addendum 17.4 Capacity (kW) & Power (kW) at 50 Hz for refrigerant R404A

Model	Ambient Temp.°C	Capacity (kW)							Power (kW)						
		Evaporating Temperature (°C)							Evaporating Temperature (°C)						
		-25	-20	-15	-10	-5	0	5	-25	-20	-15	-10	-5	0	5
ZX020E	27	2.74	3.30	3.90	4.44	5.08	5.79	6.60	1.62	1.65	1.68	1.72	1.78	1.89	2.05
	32	2.50	3.06	3.59	4.12	4.68	5.29	5.96	1.78	1.81	1.83	1.86	1.92	2.02	2.17
	38	1.71	2.22	2.70	3.16	3.64	4.16	4.73	2.00	2.01	2.02	2.04	2.09	2.18	2.32
	43	1.39	1.94	2.43	2.89	3.34	3.81	4.30	2.25	2.25	2.25	2.26	2.29	2.36	2.49
ZX030E	27	3.02	3.75	4.64	5.69	6.89	8.24	9.73	2.14	2.18	2.23	2.28	2.36	2.46	2.59
	32	2.78	3.54	4.44	5.48	6.65	7.95	9.37	2.41	2.44	2.48	2.54	2.61	2.72	2.86
	38	2.52	3.38	4.36	5.46	6.66	7.97	9.38	2.75	2.77	2.80	2.85	2.93	3.05	3.20
	43	1.84	2.85	3.95	5.15	6.43	7.81	9.26	3.01	3.11	3.14	3.19	3.27	3.39	3.56
ZX040E	27	4.37	5.36	6.38	7.48	8.70	10.08	11.68	2.69	2.78	2.92	3.08	3.24	3.38	3.43
	32	3.98	4.96	5.93	6.93	8.01	9.20	10.56	2.99	3.08	3.22	3.38	3.53	3.6	3.76
	38	3.47	4.48	5.44	6.38	7.36	8.40	9.57	3.42	3.52	3.65	3.79	3.93	4.05	4.11
	43	2.78	3.87	4.86	5.78	6.69	7.61	8.60	3.87	3.95	4.08	4.21	4.32	4.42	4.47
ZX050E	27	6.03	7.49	9.05	10.67	12.31	13.93	15.51	3.48	3.52	3.6	3.72	3.88	4.1	4.37
	32	5.10	6.56	8.12	9.76	11.43	13.10	14.74	3.91	3.96	4.05	4.17	4.34	4.55	4.82
	38	4.18	5.56	7.07	8.67	10.32	11.98	13.63	4.38	4.43	4.51	4.62	4.78	4.98	5.23
	43	3.61	4.88	6.28	7.79	9.37	10.98	12.58	4.90	4.93	4.99	5.08	5.21	5.39	5.60
ZX060E	27	6.28	7.80	9.43	11.23	13.30	15.69	18.48	3.75	3.83	3.99	4.22	4.50	4.80	5.12
	32	6.06	7.53	9.06	10.72	12.58	14.72	17.20	4.5	4.57	4.72	4.93	5.2	5.5	5.78
	38	5.22	6.74	8.25	9.83	11.55	13.48	15.69	5.07	5.12	5.25	5.45	5.68	5.94	6.21
	43	4.27	5.90	7.48	9.07	10.74	12.57	14.63	5.78	5.81	5.91	6.08	6.29	6.52	6.76
ZX075E	27	7.18	8.89	10.71	12.75	15.07	17.76	20.13	4.09	4.17	4.35	4.60	4.90	5.24	5.58
	32	6.72	8.33	10.01	11.82	13.86	16.20	18.92	4.90	4.98	5.14	5.38	5.66	5.98	6.30
	38	5.66	7.30	8.43	10.62	12.47	14.54	16.92	5.53	5.58	5.73	5.94	6.19	6.48	6.77
	43	4.52	6.26	7.93	9.61	11.38	13.32	15.50	6.30	6.33	6.45	6.63	6.85	7.11	7.37

Note: Capacity at 18.3°C return gas temperature and 0 K sub cooling

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